

Visualization of Complex Observational and Theoretical Datasets in the Virtual Observatory

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Abstract. Our presentation is aimed at data centers providing access to complex observational and theoretical data and to the users of these resources. We show how to visualize complex datasets stored in the VO enabled data archives using existing VO client software and PLASTIC, a prototype of an application messaging protocol, for interaction between archive query results and tools. We demonstrate how to display and explore observable IFU datasets, provided within the ASPID-SR archive, using CDS Aladin, ESA VOSpec, and VO-Paris Euro3D Client. In the second part of the paper we show how to use TOPCAT for displaying results of N-body simulations of galaxy mergers available in the HORIZON GalMer database.

1. Introduction

At present the International Virtual Observatory has become a rapidly growing initiative. Recently, several VO resources providing access to complex observational and theoretical datasets have appeared. Providing the transparent and efficient data access and visualization mechanisms are the crucial points for data sources to be used by the scientific community.

In this paper we demonstrate how to visualize complex observable and theoretical datasets stored in the VO-enabled data archives using a WEB-browser, existing VO client software and PLASTIC (PLatform for Astronomical Tools Inter-Connection), a prototype of an application messaging protocol, for interaction between archive query results and tools. The technical details of the middle layer software implementation are given in a paper “Middleware for data visualization in VO-enabled data archives” by Zolotukhin & Chilingarian (this volume).

2. ASPID-SR Archive

ASPID-SR (Chilingarian et al. 2007a) is a prototype of an archive of heterogeneous science ready data, containing observations obtained at the Russian 6-m

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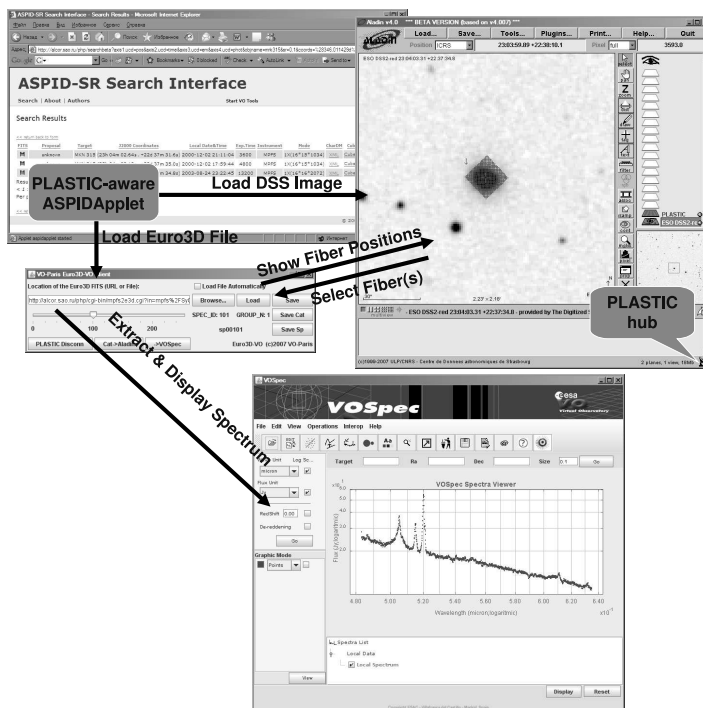


Figure 1. Interaction between the ASPID-SR web-interface, CDS Aladin, ESA VOSpec, and VO-Paris Euro3D Client.

telescope. This resource provides the world largest collection of science-ready 3D spectroscopic data, including about a hundred integral-field unit (IFU) datasets mostly for extragalactic objects and scanning Fabry-Perot interferometric observations (about 70 data-cubes for nearby galaxies in $H\alpha$ and [OIII] emission lines).

ASPID-SR provides implementation for several existing IVOA standards: Characterisation Data Model (Louys et al. 2007, one of the reference implementations), Spectrum Data Model (McDowell et al. 2007) Simple Spectral Access Protocol (Tody et al. 2007).

Interaction between VO client applications and the ASPID-SR archive interface is implemented in several stages:

1. Querying the XML characterisation metadata (Zolotukhin et al. 2007) using the web interface.
2. Light-weight Java applet is integrated into the HTML pages, containing the query response; it detects a PLASTIC hub, connects to it, and checks whether other tools (Aladin, VOSpec, VO Paris Euro3D Client) are registered within it. If the applications are not detected, they are started using JavaScript and Java WebStart.
3. As soon as all the used applications have been started and registered within the PLASTIC hub, a small script is sent to CDS Aladin to display the DSS2 image of the area, corresponding to the position of the IFU field of view. At the same time, the IFU dataset in the Euro3D FITS format (Kissler-

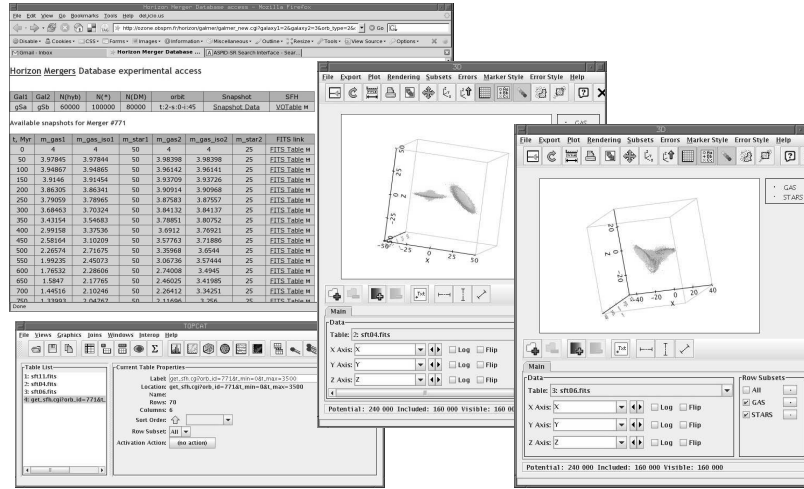


Figure 2. This figure demonstrates interaction between the Horizon GalMer Database, containing the results of N-body simulations, and TOPCAT used for visualization. Two snapshots of a merger of giant Sa and Sc galaxies are shown.

Patig et al. 2004) is loaded into VO Paris Euro3D Client (Chilingarian et al. 2007b).

4. Positions of IFU fibers are sent from VO Paris Euro3D Client to CDS Aladin and overplotted on the DSS2 image.
5. User can interactively select either groups of fibers or individual ones using CDS Aladin. An extracted spectrum (or co-added spectra of several fibers) is sent to ESA VOSpec using PLASTIC by clicking on the corresponding button in the user interface of VO Paris Euro3D Client.

This implementation follows the principles of handling 3D spectral datasets, proposed and described in Chilingarian et al. (2006)

3. The Horizon GalMer Database

The Horizon GalMer database (Di Matteo et al. 2007a) contains results of N-body simulations of mergers of galaxies (Di Matteo et al. 2007b) of different morphological types. To model the galaxy evolution, the Tree-SPH code is used, where gravitational forces are calculated using a hierarchical tree method and gas evolution is followed by means of smoothed particle hydrodynamics. The first release of the data contains about 900 simulations (with limited inclination angles of the orbits), in 50 to 70 snapshots each, representing mergers of giant galaxies of different morphological types (E0 to Sd).

The web-based access to the simulation results is provided. The middleware described in Zolotukhin & Chilingarian (this conference) is used to provide PLASTIC based communication between archive web-pages and TOPCAT used as a tool for displaying the 3-dimensional snapshot datasets, as well as star formation histories of the merging galaxies.

The Horizon GalMer database implements a prototype of IVOA Simple Numeric Access Protocol Data Model (Lemson et al., in prep.) serialized as the relational database schema.

4. Summary

The two implementations described above demonstrate that the observable and theoretical datasets having complex structure can be discovered and accessed at the present stage of the Virtual Observatory development, when not all the interoperability standards are yet established. A WEB-browser and existing client applications interacting via simple application messaging protocol such as PLASTIC provide an infrastructure powerful enough for scientific usage of the data sources in a VO framework.

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